09/517417

C of C

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	Patent#: 7,103,015
Filing Date	Issued: September 5, 2006
First Named Inventor	Olivier Isson et al.
Art Unit	2616
Examiner Name	Dmitry Levitan
Total Number of Pages in This Submission	Attorney Docket Number: S1022.80316US00

ENCLOSURES (*Check all that apply*)

- [ ] Fee Transmittal Form
- [ ] Fee Attached
- [ ] Amendment/Reply
- [ ] After Final
- [ ] Affidavits/declaration(s)
- [ ] Extension of Time Request
- [x] Request for Certificate of Correction
- [x] Certificate of Correction
- [ ] Certified Copy of Priority Document(s)
- [ ] Reply to Missing Parts/ Incomplete Application
- [ ] Reply to Missing Parts under 37 CFR 1.52 or 1.53
- [ ] Drawing(s)
- [x] Copy of Informal Communication
- [x] Copy of Examiner's Amendment
- [x] Copy of Title Page and Cols. 6, 7 and 8 of U.S. Patent No. 7,103,015
- [x] Copy of Declaration and Power of Attorney
- [ ] Terminal Disclaimer
- [ ] Request for Refund
- [ ] CD, Number of CD(s) _____
- [ ] Landscape Table on CD
- [ ] After Allowance Communication to TC
- [ ] Appeal Communication to Board of Appeals and Interferences
- [ ] Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- [ ] Proprietary Information
- [ ] Status Letter
- [x] Other Enclosure(s) (please Identify below):

Return Receipt Postcard

Remarks

Certificate SEP 18 2006 of Correction

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	WOLF, GREENFIELD & SACKS, P.C.		
Signature			
Printed name	James H. Morris		
Date	September 11, 2006	Reg. No.	34,681

Certificate of Mailing Under 37 CFR 1.8(a)

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being deposited with the U.S. Postal Service on the date shown below with sufficient postage as First Class Mail, in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Dated: September 11, 2006

Signature: _____ (Gail Driscoll)

SEP 19 2006

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	Patent#: 7,103,015
Filing Date	Issued: September 5, 2006
First Named Inventor	Olivier Isson et al.
Art Unit	2616
Examiner Name	Dmitry Levitan
Total Number of Pages in This Submission	Attorney Docket Number: S1022.80316US00

ENCLOSURES (*Check all that apply*)

- [ ] Fee Transmittal Form
- [ ] Fee Attached
- [ ] Amendment/Reply
- [ ] After Final
- [ ] Affidavits/declaration(s)
- [ ] Extension of Time Request
- [x] Request for Certificate of Correction
- [x] Certificate of Correction
- [ ] Certified Copy of Priority Document(s)
- [ ] Reply to Missing Parts/ Incomplete Application
- [ ] Reply to Missing Parts under 37 CFR 1.52 or 1.53
- [ ] Drawing(s)
- [x] Copy of Informal Communication
- [x] Copy of Examiner's Amendment
- [x] Copy of Title Page and Cols. 6, 7 and 8 of U.S. Patent No. 7,103,015
- [x] Copy of Declaration and Power of Attorney
- [ ] Terminal Disclaimer
- [ ] Request for Refund
- [ ] CD, Number of CD(s) _____
- [ ] Landscape Table on CD
- [ ] After Allowance Communication to TC
- [ ] Appeal Communication to Board of Appeals and Interferences
- [ ] Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- [ ] Proprietary Information
- [ ] Status Letter
- [x] Other Enclosure(s) (please Identify below):

Return Receipt Postcard

Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	WOLF, GREENFIELD & SACKS, P.C.		
Signature			
Printed name	James H. Morris		
Date	September 11, 2006	Reg. No.	34,681

Certificate of Mailing Under 37 CFR 1.8(a)

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being deposited with the U.S. Postal Service on the date shown below with sufficient postage as First Class Mail, in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Dated: September 11, 2006

Signature: _____ (Gail Driscoll)

Docket No.: S1022.80316US00
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Olivier Isson and Tomas Nordström	
Serial No.:	09/517,417	Patent No. 7,103,015
Filed:	March 2, 2000	Issued: September 5, 2006
For:	DSL TRANSMISSION SYSTEM WITH MEANS FOR ENSURING LOCAL ECHO ORTHOGONALITY	
Examiner:	Dmitry Levitan	
Art Unit:	2616	Confirmation No. 4387

Certificate of Mailing Under 37 CFR 1.8(a)
I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being deposited with the U.S. Postal Service on the date shown below with sufficient postage as First Class Mail, in an envelope addressed to: Attention: Certificate of Correction Branch, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Dated: September 11, 2006

Gail Driscoll

REQUEST FOR CERTIFICATE OF CORRECTION
PURSUANT TO 37 CFR 1.322

Attention: Certificate of Correction Branch
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Upon reviewing the above-identified patent, Patentee noted typographical errors which should be corrected.

On the title page:

The family name of the second named inventor should have an umlaut over the second "o". Item (75) should read:

(75) Inventors: Olivier Isson, La Tronche (FR); Tomas Nordström, Lulea (SE)

In the Claims:

Claims 2-6, 8, and 15 should read as shown below.

2. The system of claim 1, further comprising:

a finite impulse response filter having a size adapted for processing samples of the

outgoing time domain symbols only during said predetermined time interval, comprising means for continuously calculating filter coefficients from the outgoing time domain signals received and transmitted on the subscriber line.

3. The system of claim 1, wherein the predetermined time interval is equal to a maximum delay between the incoming and outgoing time domain symbols.

4. The system of claim 1, further comprising:

a FIFO memory receiving the outgoing time domain symbols;

a subtractor arranged for subtracting the outgoing time domain symbols from output of the FIFO memory;

a filter receiving output of the subtractor and enabled only during said predetermined time interval from an end of each outgoing time domain symbol; and

an adder receiving the output of the filter and said incoming time domain symbols.

5. The system of claim 4, wherein the FIFO memory has a size for storing only a beginning portion of each outgoing time domain symbol, is write-enabled during said predetermined time interval from the beginning of each outgoing time domain symbol, and read-enabled during said predetermined time interval from the end of each outgoing time domain symbol.

6. In a digital subscriber line (DSL) transmission system in which at least a first outgoing symbol and a second outgoing symbol are successively transmitted, at least one incoming symbol is received, and an echo of the first outgoing symbol and an echo of the second outgoing symbol are successively received as part of an echo signal, a method comprising an act of:

(A) making sub-carriers of a first portion of the echo signal, the first portion being less than all of the echo signal, orthogonal to sub-carriers of the at least one incoming symbol by replacing ~~a~~ the first portion of the echo of the second outgoing symbol with an estimation of a first portion of the echo of the first outgoing symbol.

8. The method of claim 7 wherein:

the first outgoing symbol and the second outgoing symbol have a same total length; and the length of the first portion of the echo of the second outgoing symbol and the first portion of the echo of the first outgoing symbol does not exceed 5% of the total length.

15. In a digital subscriber line (DSL) transmission system in which at least a first outgoing symbol and a second outgoing symbol are successively transmitted, at least one incoming symbol is received, and an echo of the first outgoing symbol and an echo of the second outgoing signal are successively received as part of an echo signal, an apparatus comprising:

a circuit to make sub-carriers of a first portion of the echo signal, the first portion being less than all of the echo signal, orthogonal to sub-carriers of the at least one incoming symbol, the circuit operative to replace ~~a~~ the first portion of the echo of the second outgoing-symbol with an estimation of a first portion of the echo of the first outgoing symbol.

The changes made by Examiner's amendment, found on page 2 and attachment A of the Supplemental Notice of Allowance mailed from the Patent Office on June 19, 2006, were not incorporated into the issued patent, U.S. Patent No. 7,103,015.

Patentees respectfully submit that, since the errors for which a Certificate of Correction is sought was the result of Patent Office mistake, no fee is due. However, if the Examiner deems a fee necessary, the fee may be charged to the account of the undersigned, Deposit Account No. 23/2825.

Transmitted herewith is a proposed Certificate of Correction effecting such amendment. Patentee respectfully solicits the granting of the requested Certificate of Correction.

Dated: September 11, 2006

Respectfully submitted,

By: _____

James H. Morris
Registration No.: 34,681
WOLF, GREENFIELD & SACKS, P.C.
Federal Reserve Plaza
600 Atlantic Avenue
Boston, Massachusetts 02210-2206
(617) 646-8000

PTO/SB/44 (04-05)
Approved for use through 04/30/2007. OMB 0651-0033
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.
(Also Form PTO-1050)

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO.	:	7,103,015
APPLICATION NO.	:	09/517,417
ISSUE DATE	:	September 5, 2006
INVENTOR(S)	:	Olivier Isson and Tomas Nordström,

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the title page item (75) should read:
(75) Inventors: Olivier Isson, La Tronche (FR); Lulea (SE)

Claims 2-6, 8, and 15 should read:

2. The system of claim 1, further comprising:

a finite impulse response filter having a size adapted for processing samples of the outgoing time domain symbols only during said predetermined time interval, comprising means for continuously calculating filter coefficients from the outgoing time domain signals received and transmitted on the subscriber line.

3. The system of claim 1, wherein the predetermined time interval is equal to a maximum delay between the incoming and outgoing time domain symbols.

4. The system of claim 1, further comprising:

a FIFO memory receiving the outgoing time domain symbols;

a subtractor arranged for subtracting the outgoing time domain symbols from output of the FIFO memory;

a filter receiving output of the subtractor and enabled only during said predetermined time interval from an end of each outgoing time domain symbol; and

an adder receiving the output of the filter and said incoming time domain symbols.

MAILING ADDRESS OF SENDER (Please do not use customer number below):
James H. Morris
WOLF, GREENFIELD & SACKS, P.C.
Federal Reserve Plaza
600 Atlantic Avenue
Boston, Massachusetts 02210-2206

PTO/SB/44 (04-05)
Approved for use through 04/30/2007. OMB 0651-0033
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.
(Also Form PTO-1050)

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 7,103,015

APPLICATION NO. : 09/517,417

ISSUE DATE : September 5, 2006

INVENTOR(S) : Olivier Isson and Tomas Nordström,

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

5. The system of claim 4, wherein the FIFO memory has a size for storing only a beginning portion of each outgoing time domain symbol, is write-enabled during said predetermined time interval from the beginning of each outgoing time domain symbol, and read-enabled during said predetermined time interval from the end of each outgoing time domain symbol.

6. In a digital subscriber line (DSL) transmission system in which at least a first outgoing symbol and a second outgoing symbol are successively transmitted, at least one incoming symbol is received, and an echo of the first outgoing symbol and an echo of the second outgoing symbol are successively received as part of an echo signal, a method comprising an act of:

(A) making sub-carriers of a first portion of the echo signal, the first portion being less than all of the echo signal, orthogonal to sub-carriers of the at least one incoming symbol by replacing a the first portion of the echo of the second outgoing symbol with an estimation of a first portion of the echo of the first outgoing symbol.

8. The method of claim 7 wherein:

the first outgoing symbol and the second outgoing symbol have a same total length; and the length of the first portion of the echo of the second outgoing symbol and the first portion of the echo of the first outgoing symbol does not exceed 5% of the total length.

MAILING ADDRESS OF SENDER (Please do not use customer number below):
James H. Morris
WOLF, GREENFIELD & SACKS, P.C.
Federal Reserve Plaza
600 Atlantic Avenue
Boston, Massachusetts 02210-2206

PTO/SB/44 (04-05)
Approved for use through 04/30/2007. OMB 0651-0033
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.
(Also Form PTO-1050)

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO.	:	7,103,015
APPLICATION NO.	:	09/517,417
ISSUE DATE	:	September 5, 2006
INVENTOR(S)	:	Olivier Isson and Tomas Nordström,

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

15. In a digital subscriber line (DSL) transmission system in which at least a first outgoing symbol and a second outgoing symbol are successively transmitted, at least one incoming symbol is received, and an echo of the first outgoing symbol and an echo of the second outgoing signal are successively received as part of an echo signal, an apparatus comprising:

a circuit to make sub-carriers of a first portion of the echo signal, the first portion being less than all of the echo signal, orthogonal to sub-carriers of the at least one incoming symbol, the circuit operative to replace a the first portion of the echo of the second outgoing-symbol with an estimation of a first portion of the echo of the first outgoing symbol.

MAILING ADDRESS OF SENDER (Please do not use customer number below):
James H. Morris
WOLF, GREENFIELD & SACKS, P.C.
Federal Reserve Plaza
600 Atlantic Avenue
Boston, Massachusetts 02210-2206

US007103015B1

(12) **United States Patent**
Isson et al.

(10) **Patent No.: US 7,103,015 B1**
(45) **Date of Patent: Sep. 5, 2006**

(54) **DSL TRANSMISSION SYSTEM WITH MEANS FOR ENSURING LOCAL ECHO ORTHOGONALITY**

(75) Inventors: **Olivier Isson**, La Tronche (FR); **Tomas Nordstrom**, Lulea (SE)

(73) Assignees: **STMicroelectronics S.A.**, Gentilly (FR); **Tella AB**, Farsta (SE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/517,417**

(22) Filed: **Mar. 2, 2000**

(30) **Foreign Application Priority Data**

Mar. 5, 1999 (EP) 99410014

(51) **Int. Cl.**
H04B 3/20 (2006.01)

(52) **U.S. Cl.** **370/290**

(58) **Field of Classification Search** 370/276, 370/286–292; 379/3; 455/570; 375/148
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,084,865	A *	1/1992	Koike	370/289
5,317,596	A	5/1994	Ho et al.	375/14
5,521,908	A *	5/1996	Younce et al.	370/286
5,577,116	A *	11/1996	Townsend et al.	379/406.12
5,623,513	A *	4/1997	Chow et al.	375/219
5,668,802	A *	9/1997	Chalmers et al.	370/276
5,751,716	A *	5/1998	Tzannes et al.	370/468
6,072,782	A *	6/2000	Wu	370/286
6,377,683	B1 *	4/2002	Dobson et al.	379/406.12
6,535,550	B1 *	3/2003	Cole	375/222
6,546,055	B1 *	4/2003	Schmidl et al.	375/244
6,845,125	B1 *	1/2005	Sasaki et al.	375/219

FOREIGN PATENT DOCUMENTS

WO	WO 97/06619	2/1997

OTHER PUBLICATIONS

European Search Report from European Application 99410014.7, filed Mar. 5, 1999.

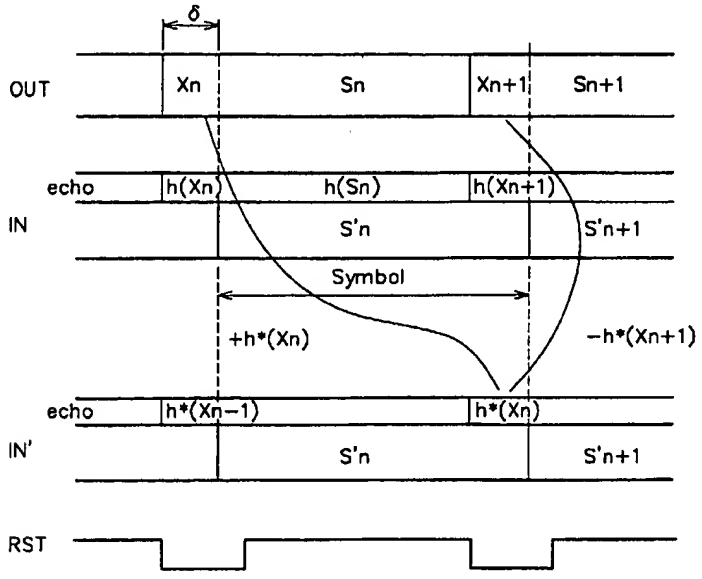
* cited by examiner

Primary Examiner—Dmitry Levitan
(74) *Attorney, Agent, or Firm*—Lisa K. Jorgenson; James H. Morris; Wolf, Greenfield & Sacks, P.C.

(57) **ABSTRACT**

A digital subscriber line transmission system comprising an IFFT circuit generating successive outgoing time domain symbols on a subscriber line from respective groups of digital frequency domain coefficients; an FFT circuit generating groups of digital frequency domain coefficients from respective incoming time domain symbols received on the subscriber line, a current incoming symbol being delayed with respect to a current outgoing symbol by a predetermined time interval; and circuitry for, during an end portion of a current incoming symbol, subtracting from the signal received on the subscriber line an estimated echo obtained by a filter from a signal portion following the end of the current outgoing symbol, and adding thereto, through said filter, a beginning portion of the current outgoing symbol, wherein said portions have a duration at least equal to said predetermined time interval.

23 Claims, 4 Drawing Sheets



is shorter than the maximum value, it is possible to correspondingly reduce the number of weighting coefficients to calculate.

FIG. **7** schematically shows an embodiment of a circuit implementing the principle described in relation with FIG. **6**. The outgoing time domain symbols S, i.e. the output OUT of IFFT circuit **14** of FIG. **1**, are provided to a digital delay line **80** which introduces a delay of one symbol. The outgoing symbols S are also subtracted from the output of the delay line **80** by a subtractor **82**. Subtractor **82** thus provides the difference between an outgoing symbol Sn and the next outgoing symbol Sn+1. This difference is provided to an FIR filter **84** which is adjusted to have the estimated transfer function h* of the local echo generation.

As previously mentioned, filter **84** is designed to operate only on a number of samples corresponding to delay δ or the maximum value thereof. When filter **84** does not receive samples for which an echo should be estimated, it is held at a reset state so that it provides value zero. An exemplary reset signal RST is illustrated in FIG. **6**. It is inactive from the beginning of each outgoing symbol for a duration corresponding to the maximum value of delay δ.

In fact, with the structure of FIG. **7**, filter **84** estimates the echo of the difference of two symbol portions (the subtraction is achieved by element **82** before the filter) which, since the filter is linear, is equivalent to the subtraction of the echoes of the two portions.

The output of filter **84** is provided to an adder **86** which also receives the incoming symbols S' affected by the non-orthogonal echo. Adder **86** provides the input signal IN' of FFT circuit **18**, which signal has the desired orthogonal echo.

The necessary weighting coefficients for filter **84** are provided by a calculating element **88** which implements a conventional echo-canceller algorithm using the input and output signals IN and OUT. Since this calculation algorithm does not depend on the output of the filter, the calculation may continue even during the periods when filter **84** is inactive. The weighting coefficients being evaluated by successive iterations, this permanent operation of the algorithm will allow a faster convergence of the weighting coefficients, especially at start-up of the system.

Since filter **84** is operative only during short time periods, at the beginning of each outgoing symbol, it is not necessary to store a whole symbol in delay line **80**. Delay line **80** may be chosen of a size adapted to storing only the necessary portion of each symbol. In this case, delay line **80** is enabled only during the periods when the reset signal RST of the filter is inactive.

For sake of clarity, conventional cyclic prefixes were not considered in the above description. Such prefixes are however used most of the time.

In FIG. **8**, cyclic prefixes CP are added to the symbols. This figure shows the incoming signal IN affected by the echo of the outgoing signal. A current incoming symbol S'n overlaps the echo of the current outgoing symbol Sn and of the prefix of the next outgoing symbol Sn+1. In this case, it is the echo of the prefix of the next outgoing symbol that is replaced by the echo of the beginning portion of the current outgoing symbol.

In fact, as a general rule for signals with or without cyclic prefixes, the echo portion coming after the echo of an outgoing symbol is replaced by the echo of the beginning portion of the outgoing symbol.

The delay line **80** is in fact a FIFO memory which is write enabled at least for time δ from the beginning of each outgoing symbol and read enabled when filter **84** is operative, i.e. for at least time δ from the end of each outgoing symbol. Corresponding write, read, and reset signals W, R, RST are shown in FIG. **8**.

Such alterations, modifications, and improvements are intended to be part of this disclosure, and are intended to be within the spirit and the scope of the invention. Accordingly, the foregoing description is by way of example only and is not intended to be limiting. The invention is limited only as defined in the following claims and the equivalents thereto.

What is claimed is:

1. A digital subscriber line transmission system comprising:

an inverse fast Fourier transform circuit generating successive outgoing time domain symbols without cyclic suffixes on a subscriber line from respective groups of digital frequency domain coefficients;

a fast Fourier transform circuit generating groups of digital frequency domain coefficients from respective incoming time domain symbols received on the subscriber line, a current incoming symbol being delayed with respect to a current outgoing symbol by a predetermined time interval; and

a processing circuit for making sub-carriers of a local echo of the outgoing time domain symbols orthogonal to sub-carriers of the incoming time domain symbols, said processing circuit comprising means for adding to said incoming time domain symbols an estimated echo obtained by filtering the difference between a signal portion following the end of the current outgoing symbol and a beginning portion of the current outgoing symbol, wherein said portions have a duration at least equal to said predetermined time interval.

2. The system of claim **1**, wherein the filter is a finite impulse response filter having a size adapted for processing samples of the symbols only during said predetermined time interval, comprising means for continuously calculating filter coefficients from the signals received and transmitted on the subscriber line.

3. The system of claim **1**, wherein the predetermined time interval is equal to a maximum delay between the incoming and outgoing symbols.

4. The system of claim **1**, further comprising:

a FIFO memory receiving the outgoing symbols;

a subtractor arranged for subtracting the outgoing symbols from the output of the FIFO memory;

said filter receiving the output of the subtractor and enabled only during said predetermined time interval from the end of each outgoing symbol; and

an adder receiving the output of the filter and said incoming symbols.

5. The system of claim **4**, wherein the FIFO memory has a size for storing only the beginning portion of each outgoing symbol, is write-enabled during said predetermined time interval from the beginning of each outgoing symbol, and read-enabled during said predetermined time interval from the end of each outgoing symbol.

6. In a digital subscriber line (DSL) transmission system in which at least a first outgoing symbol and a second outgoing symbol are successively transmitted, at least one incoming symbol is received, and an echo of the first outgoing symbol and an echo of the second outgoing symbol are successively received as part of an echo signal, a method comprising an act of:

(A) making sub-carriers of the echo signal orthogonal to sub-carriers of the at least one incoming symbol by replacing a first portion of the echo of the second

outgoing symbol with the an estimation of a first portion of the echo of the first outgoing symbol.

7. The method of claim 6 wherein the first portion of the echo of the second outgoing signal and the first portion of the echo of the first outgoing symbol have a same length that is less than or equal to a maximum delay between transmitted and received symbols.

8. The method of claim 7 wherein:

each of the first outgoing symbol and the second outgoing symbol have a same total length; and

the length of the first portion of the echo of the second outgoing symbol and the first portion of the echo of the first outgoing symbol does not exceed 5% of the total length.

9. The method of claim 6 wherein the act A) comprises acts of:

A1) obtaining a difference between a first portion of the first outgoing symbol and a first portion of the second outgoing symbol;

A2) applying an estimated transfer function of echo generation to the difference to generate an echo compensation signal; and

A3) adding the echo compensation signal to at least the first portion of the echo of the second outgoing symbol.

10. The method of claim 9, wherein the act A1) includes an act of:

applying a one symbol delay to at least the first and second outgoing symbols.

11. The method of claim 10, wherein the act A2) includes an act of:

passing the difference through a finite impulse response filter having the estimated transfer function of the echo generation.

12. The method of claim 10, wherein the act A2) includes an act of:

calculating the estimated transfer function based at least on a plurality of outgoing symbols and a plurality of incoming symbols.

13. The method of claim 12, wherein each outgoing symbol and each incoming symbol has a total symbol length, and wherein the act of calculating the estimated transfer function includes an act of:

calculating the estimated transfer function based only on a portion of the total symbol length.

14. The method of claim 13, wherein the act of calculating the estimated transfer function includes an act of calculating the estimated transfer function based on approximately 5% of a total number of samples of each symbol.

15. In a digital subscriber line (DSL) transmission system in which at least a first outgoing symbol and a second outgoing symbol are successively transmitted, at least one incoming symbol is received, and an echo of the first outgoing symbol and an echo of the second outgoing signal are successively received as part of an echo signal, an apparatus comprising:

a circuit to make sub-carriers of the echo signal orthogonal to sub-carriers of the at least one incoming symbol, the circuit operative to replace a first portion of the echo of the second outgoing symbol with an estimation of a first portion of the echo of the first outgoing symbol.

16. The apparatus of claim 15, wherein the first portion of the echo of the second outgoing signal and the first portion of the echo of the first outgoing symbol have a same length that is less than or equal to a maximum delay between transmitted and received symbols.

17. The apparatus of claim 16, wherein:

the first outgoing symbol and the second outgoing symbol have a same total length; and

the length of the first portion of the echo of the second outgoing signal and the first portion of the echo of the first outgoing symbol does not exceed 5% of the total length.

18. The apparatus of claim 15, wherein the circuit is configured to:

obtain a difference between a first portion of the first outgoing symbol and a first portion of the second outgoing symbol;

apply an estimated transfer function of echo generation to the difference to generate an echo compensation signal; and

add the echo compensation signal to at least the first portion of the echo of the second outgoing symbol.

19. The apparatus of claim 18, wherein the circuit includes at least one delay unit configured to apply a one symbol delay to at least the first and second outgoing symbols.

20. The apparatus of claim 19, wherein the circuit further includes a finite impulse response filter, coupled to the at least one delay unit and having the estimated transfer function of the echo generation, to process the difference.

21. The apparatus of claim 20, wherein the circuit further includes at least one calculating unit configured to calculate the estimated transfer function based at least on a plurality of outgoing symbols and a plurality of incoming symbols.

22. The apparatus of claim 21, wherein each outgoing symbol and each incoming symbol has a total symbol length, and wherein the at least one calculating unit is configured to calculate the estimated transfer function based only on a portion of the total symbol length.

23. The apparatus of claim 22, wherein the at least one calculating unit is configured to calculate the estimated transfer function based on approximately 5% of a total number of samples of each symbol.

* * * * *

Amendment, filed 03/17/06, has been entered.

Drawings

1. The drawings were received on 3/17/06. These drawings are approved.

EXAMINER'S AMENDMENT

2. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Daniel P. McLoughlin on 4/12/06.

The application has been amended as follows:

Claims 1-6, 9-17 and 20-27 have been amended per Attachment A.

Note. Claims have been amended to eliminate the antecedent issues and to avoid reading on the Admitted Prior Art.

Allowable Subject Matter

3. Claims 1-6, 9-17 and 20-27 are allowed.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dmitry Levitan whose telephone number is (571) 272-3093. The examiner can normally be reached on 8:30 to 4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Doris To can be reached on (571) 272-7529. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Dmitry Levitan
Examiner
Art Unit 2616

Attachment A.

1. A digital subscriber line transmission system comprising:

an inverse fast Fourier transform circuit generating successive outgoing time domain symbols without cyclic suffixes on a subscriber line from respective groups of digital frequency domain coefficients;

a fast Fourier transform circuit generating groups of digital frequency domain coefficients from respective incoming time domain symbols received on the subscriber line, a current incoming symbol being delayed with respect to a current outgoing symbol by a predetermined time interval; and

a processing circuit for making sub-carriers of a local echo of the outgoing time domain symbols orthogonal to sub-carriers of the incoming time domain symbols, said processing circuit comprising means for adding to said incoming time domain symbols an estimated echo obtained by filtering the difference between a signal portion following the end of the current outgoing symbol and a beginning portion of the current outgoing symbol, wherein said portions have a duration at least equal to said predetermined time interval.

2. The system of claim 1, ~~wherein the filter is~~ further comprising:

a finite impulse response filter having a size adapted for processing samples of the outgoing time domain symbols only during said predetermined time interval, comprising means for continuously calculating filter coefficients from the outgoing time domain signals received and transmitted on the subscriber line.

3. The system of claim 1, wherein the predetermined time interval is equal to a maximum delay between the incoming and outgoing time domain symbols.

4. The system of claim 1, further comprising:

a FIFO memory receiving the outgoing time domain symbols;

a subtractor arranged for subtracting the outgoing time domain symbols from ~~the~~ output of the FIFO memory;

~~said~~ a filter receiving ~~the~~ output of the subtractor and enabled only during said

predetermined time interval from ~~the~~ an end of each outgoing time domain symbol; and

an adder receiving the output of the filter and said incoming time domain symbols.

5. The system of claim 4, wherein the FIFO memory has a size for storing only ~~the~~ a beginning portion of each outgoing time domain symbol, is write-enabled during said predetermined time interval from the beginning of each outgoing time domain symbol, and read-enabled during said predetermined time interval from the end of each outgoing time domain symbol.

6. In a digital subscriber line (DSL) transmission system in which at least a first outgoing symbol and a second outgoing symbol are successively transmitted, at least one incoming symbol is received, and an echo of the first outgoing symbol and an echo of the second outgoing symbol are successively received as part of an echo signal, a method comprising an act of:

(A) making sub-carriers of a first portion of the echo signal, the first portion being less than all of the echo signal, orthogonal to sub-carriers of the at least one incoming symbol by replacing ~~a~~ the first portion of the echo of the second outgoing symbol with an estimation of a first portion of the echo of the first outgoing symbol.

7. (Canceled)

8. (Canceled)

9. The method of claim 6 wherein the first portion of the echo of the second outgoing signal and the first portion of the echo of the first outgoing symbol have a same length that is less than or equal to a maximum delay between transmitted and received symbols.

10. The method of claim 9 wherein:

~~each of~~ the first outgoing symbol and the second outgoing symbol have a same total length; and

the length of the first portion of the echo of the second outgoing symbol and the first portion of the echo of the first outgoing symbol does not exceed 5% of the total length.

11. The method of claim 6 wherein the act A) comprises acts of:

A1) obtaining a difference between a first portion of the first outgoing symbol and a first portion of the second outgoing symbol;

A2) applying an estimated transfer function of echo generation to the difference to generate an echo compensation signal; and

A3) adding the echo compensation signal to at least the first portion of the echo of the second outgoing symbol.

12. The method of claim 11, wherein the act A1) includes an act of:

applying a one symbol delay to at least the first and second outgoing symbols.

13. The method of claim 12, wherein the act A2) includes an act of:

passing the difference through a finite impulse response filter having the estimated transfer function of the echo generation.

14. The method of claim 12, wherein the act A2) includes an act of:

calculating the estimated transfer function based at least on a plurality of outgoing symbols and a plurality of incoming symbols.

15. The method of claim 14, wherein each outgoing symbol and each incoming symbol has a total symbol length, and wherein the act of calculating the estimated transfer function includes an act of:

calculating the estimated transfer function based only on a portion of the total symbol length.

16. The method of claim 15, wherein the act of calculating the estimated transfer function includes an act of calculating the estimated transfer function based on approximately 5% of a total number of samples of each symbol.

UNOFFICIAL INFORMAL COMMUNICATION

VIA Facsimile Transmission
(571) 273-3093

April 12, 2006

Examiner: Dmitry Levitan
Art Unit: 2662
United States Patent and Trademark Office
Alexandria, Virginia 22313-1450

Re: U.S. Patent Application Serial No.: 09/517,417
Confirmation No: 4387
Titled: DSL TRANSMISSION SYSTEM WITH MEANS FOR ENSURING LOCAL ECHO ORTHOGONALITY
Filed: amRCH 2, 2000
Attorney Docket No.: S1022.800316US00

Dear Examiner Levitan:

We appreciate your courtesy in contacting us today regarding the proposed amendments that we submitted on April 11, 2006.

Per your request, we have further amended claims 6 and 17 below to make clear that the first portion of the echo signal is less than all of the echo signal. Should these amendments be acceptable, you are hereby authorized to enter the amendments by Examiner's Amendment. If any of the changes are unacceptable, or if any further changes are necessary, please contact me to discuss them further.

Very truly yours,

Daniel P. McLoughlin

Proposed Claim Amendments

1. A digital subscriber line transmission system comprising:

an inverse fast Fourier transform circuit generating successive outgoing time domain symbols without cyclic suffixes on a subscriber line from respective groups of digital frequency domain coefficients;

a fast Fourier transform circuit generating groups of digital frequency domain coefficients from respective incoming time domain symbols received on the subscriber line, a current incoming symbol being delayed with respect to a current outgoing symbol by a predetermined time interval; and

a processing circuit for making sub-carriers of a local echo of the outgoing time domain symbols orthogonal to sub-carriers of the incoming time domain symbols, said processing circuit comprising means for adding to said incoming time domain symbols an estimated echo obtained by filtering the difference between a signal portion following the end of the current outgoing symbol and a beginning portion of the current outgoing symbol, wherein said portions have a duration at least equal to said predetermined time interval.

2. The system of claim 1, ~~wherein the filter is~~ further comprising:

a finite impulse response filter having a size adapted for processing samples of the outgoing time domain symbols only during said predetermined time interval, comprising means for continuously calculating filter coefficients from the outgoing time domain signals received and transmitted on the subscriber line.

3. The system of claim 1, wherein the predetermined time interval is equal to a maximum delay between the incoming and outgoing time domain symbols.

4. The system of claim 1, further comprising:

a FIFO memory receiving the outgoing time domain symbols;

a subtractor arranged for subtracting the outgoing time domain symbols from ~~the~~ output of the FIFO memory;

~~said~~ a filter receiving ~~the~~ output of the subtractor and enabled only during said

predetermined time interval from ~~the~~ an end of each outgoing time domain symbol; and

an adder receiving the output of the filter and said incoming time domain symbols.

5. The system of claim 4, wherein the FIFO memory has a size for storing only ~~the~~ a beginning portion of each outgoing time domain symbol, is write-enabled during said predetermined time interval from the beginning of each outgoing time domain symbol, and read-enabled during said predetermined time interval from the end of each outgoing time domain symbol.

6. In a digital subscriber line (DSL) transmission system in which at least a first outgoing symbol and a second outgoing symbol are successively transmitted, at least one incoming symbol is received, and an echo of the first outgoing symbol and an echo of the second outgoing symbol are successively received as part of an echo signal, a method comprising an act of:

(A) making sub-carriers of a first portion of the echo signal, the first portion being less than all of the echo signal, orthogonal to sub-carriers of the at least one incoming symbol by replacing ~~a~~ the first portion of the echo of the second outgoing symbol with an estimation of a first portion of the echo of the first outgoing symbol.

7. (Canceled)

8. (Canceled)

9. The method of claim 6 wherein the first portion of the echo of the second outgoing signal and the first portion of the echo of the first outgoing symbol have a same length that is less than or equal to a maximum delay between transmitted and received symbols.

10. The method of claim 9 wherein:

~~each of~~ the first outgoing symbol and the second outgoing symbol have a same total length; and

the length of the first portion of the echo of the second outgoing symbol and the first portion of the echo of the first outgoing symbol does not exceed 5% of the total length.

11. The method of claim 6 wherein the act A) comprises acts of:

A1) obtaining a difference between a first portion of the first outgoing symbol and a first portion of the second outgoing symbol;

A2) applying an estimated transfer function of echo generation to the difference to generate an echo compensation signal; and

A3) adding the echo compensation signal to at least the first portion of the echo of the second outgoing symbol.

12. The method of claim 11, wherein the act A1) includes an act of:

applying a one symbol delay to at least the first and second outgoing symbols.

13. The method of claim 12, wherein the act A2) includes an act of:

passing the difference through a finite impulse response filter having the estimated transfer function of the echo generation.

14. The method of claim 12, wherein the act A2) includes an act of:

calculating the estimated transfer function based at least on a plurality of outgoing symbols and a plurality of incoming symbols.

15. The method of claim 14, wherein each outgoing symbol and each incoming symbol has a total symbol length, and wherein the act of calculating the estimated transfer function includes an act of:

calculating the estimated transfer function based only on a portion of the total symbol length.

16. The method of claim 15, wherein the act of calculating the estimated transfer function includes an act of calculating the estimated transfer function based on approximately 5% of a total number of samples of each symbol.

17. In a digital subscriber line (DSL) transmission system in which at least a first outgoing symbol and a second outgoing symbol are successively transmitted, at least one incoming symbol is received, and an echo of the first outgoing symbol and an echo of the second outgoing signal are successively received as part of an echo signal, an apparatus comprising:

a circuit to make sub-carriers of a first portion of the echo signal, the first portion being less than all of the echo signal, orthogonal to sub-carriers of the at least one incoming symbol, the circuit operative to replace ~~a~~ the first portion of the echo of the second outgoing-symbol with an estimation of a first portion of the echo of the first outgoing symbol.

18. (Canceled)

19. (Canceled)

20. The apparatus of claim 17, wherein the first portion of the echo of the second outgoing signal and the first portion of the echo of the first outgoing symbol have a same length that is less than or equal to a maximum delay between transmitted and received symbols.

21. The apparatus of claim 20, wherein:

the first outgoing symbol and the second outgoing symbol have a same total length; and

the length of the first portion of the echo of the second outgoing signal and the first portion of the echo of the first outgoing symbol does not exceed 5% of the total length.

22. The apparatus of claim 17, wherein the [[a]] circuit is configured to:

obtain a difference between a first portion of the first outgoing symbol and a first portion of the second outgoing symbol;

apply an estimated transfer function of echo generation to the difference to generate an echo compensation signal; and

add the echo compensation signal to at least the first portion of the echo of the second outgoing symbol.

23. The apparatus of claim 22, wherein the a circuit includes at least one delay unit configured to apply a one symbol delay to at least the first and second outgoing symbols.

24. The apparatus of claim 23, wherein the [[a]] circuit further includes a finite impulse response filter, coupled to the at least one delay unit and having the estimated transfer function of the echo generation, to process the difference.

25. The apparatus of claim 24, wherein the [[a]] circuit further includes at least one calculating unit configured to calculate the estimated transfer function based at least on a plurality of outgoing symbols and a plurality of incoming symbols.

26. The apparatus of claim 25, wherein each outgoing symbol and each incoming symbol has a total symbol length, and wherein the at least one calculating unit is configured to calculate the estimated transfer function based only on a portion of the total symbol length.

27. The apparatus of claim 26, wherein the at least one calculating unit is configured to calculate the estimated transfer function based on approximately 5% of a total number of samples of each symbol.

Declaration and Power of Attorney for Patent Application

Déclaration et Pouvoirs pour Demande de Brevet

French Language Declaration

En tant que l'inventeur nommé ci-après, je déclare par le présent acte que:

As a below named inventor, I hereby declare that:

Mon domicile, mon adresse postale, et ma nationalité sont ceux figurant ci-dessous à côté de mon nom.

My residence, post office address and citizenship are as stated next to my name.

Je crois être le premier inventeur original et unique (si un seul nom est mentionné ci-dessous), ou l'un des premiers co-inventeurs originaux (si plusieurs noms sont mentionnés ci-dessous) de l'objet revendiqué, pour lequel une demande de brevet a été déposée concernant l'invention intitulée:

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

DSL TRANSMISSION SYSTEM WITH MEANS FOR ENSURING LOCAL ECHO ORTHOGONALITY

et dont la description est fournie ci-joint à moins que la case suivante n'ait été cochée:

the specification of which is attached hereto unless the following box is checked:

☒ a été déposée le 2 MARS 2000
sous le numéro de demande des Etats-Unis ou le numéro de demande international PCT
09/517 417 et modifiée le
_____ (le cas échéant).

☒ was filed on 2 MARCH 2000
as United States Application Number or PCT International Number 09/517 417
and was amended on _____
(if applicable)

Je déclare par le présent acte avoir passé en revue et compris le contenu de la description ci-dessus, revendications comprises, telles que modifiées par toute modification dont il aura été fait référence ci-dessus.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

Je reconnais devoir divulguer toute information pertinente à la brevetabilité, comme défini dans le Titre 37, §1.56 du Code fédéral des réglementations.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

French Language Declaration

Je revendique par le présent acte avoir la priorité étrangère, en vertu du Titre 35, §119(a)-(d) ou § 365(b) du Code des Etats-Unis, sur toute demande étrangère de brevet ou certificat d'inventeur ou, en vertu du Titre 35, § 365(a) du même Code, sur toute demande internationale PCT désignant au moins un pays autre que les Etats-Unis et figurant ci-dessous et, en cochant la case, j'ai aussi indiqué ci-dessous toute demande étrangère de brevet, tout certificat d'inventeur ou toute demande internationale PCT ayant une date de dépôt précédant celle de la demande à propos de laquelle une priorité est revendiquée.

Prior foreign application(s)
Demande(s) de brevet antérieure(s)

(Number) (Numéro)	(Country) (Pays)	Priority not claimed Droit de priorité non revendiqué
99410014.7	EUROPE	
5 MARCH 1999 (Day/Month/Year Filed) (Jour/Mois/Année de dépôt)		☐
		☐
(Day/Month/Year Filed) (Jour/Mois/Année de dépôt)		

I hereby claim foreign priority under Title 35, United States Code, §119(a)-(d) or § 365(b) of any foreign applications(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below, and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed:

Je revendique par le présent acte tout bénéfice, en vertu du Titre 35 §119(e) du Code des Etats-Unis, de toute demande de brevet provisoire effectuée aux Etats-Unis et figurant ci-dessous.

(Application No.) (N° de demande)	(Filing Date) (Date de dépôt)
(Application No.) (N° de demande)	(Filing Date) (Date de dépôt)

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below.

Je revendique par le présent acte, le bénéfice, en vertu du Titre 35 § 120 du Code des Etats-Unis, de toute demande de brevet effectuée aux Etats-Unis, ou en vertu du Titre 35, § 365(c) du même Code, de toute demande internationale PCT désignant les Etats-Unis et figurant ci-dessous et, dans la mesure où l'objet de chacune des revendications de cette demande de brevet n'est pas divulgué dans la demande antérieure américaine ou internationale PCT, en vertu des dispositions du premier paragraphe du Titre 35, § 112 du Code des Etats-Unis, je reconnais devoir divulguer toute information pertinente à la brevetabilité, comme défini dans le Titre 37, § 1.56 du Code Fédéral des réglementations, dont j'ai pu disposer entre la date de dépôt de la demande antérieure et la date de dépôt de la demande nationale ou internationale PCT de la présente demande:

(Application No.) (N° de Demande)	(Filing Date) (Date de Dépôt)
(Application No.) (N° de Demande)	(Filing Date) (Date de Dépôt)

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or § 365(c) of any PCT international application(s) designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

(Status)(Patented, pending abandoned) (Statut)(breveté, en cours d'examen, abandonné)
(Status)(Patented, pending abandoned) (Statut)(breveté, en cours d'examen, abandonné)

Je déclare par le présent acte que toute déclaration ci-incluse est, à ma connaissance, véridique et que toute déclaration formulée à partir de renseignements ou de suppositions est tenue pour véridique; et de plus, que toutes ces déclarations ont été formulées en sachant que toute fausse déclaration volontaire ou son équivalent est passible d'une amende ou d'une incarcération, ou des deux, en vertu de la Section 1001 du Titre 18 du Code des Etats-Unis, et que de telles déclarations volontairement fausses risquent de compromettre la validité de la demande de brevet ou du brevet délivré à partir de celle-ci.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

French Language Declaration

POUVOIR: En tant que l'inventeur cité, je désigne par la présente l'(les) avocat(s) et/ou agent(s) suivant(s) pour qu''il(s) poursuive(nt) la procédure de cette demande de brevet et traite(nt) toute affaire s'y rapportant avec l'Office des brevets et des marques: *(mentionner le nom et le numéro d'enregistrement).*

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

David Wolf	17,528	Peter C. Lando	34,654	Paul D. Sorkin	40,212	Lisa E. Winsor	44,405
George L. Greenfield	17,756	Gary S. Engelson	35,128	John R. VanAmsterdam	33,228	Mark Steinberg	40,829
Stanley Sacks	19,900	Peter J. Gordon	35,164	Matthew B. Lowrie	36,904	Stephen R. Finch	42,534
Edward F. Perlman	28,105	Randy J. Pritzker	35,986	Robert E. Rigby, Jr.	41,316	Joseph Teja, Jr.	45,157
Lawrence M. Green	29,384	Richard F. Giunta	36,149	Robert A. Skrivanek, Jr.	40,886	Alan W. Steele	45,128
Steven J. Henry	27,900	Douglas R. Wolf	36,971	Robert M. Abrahamsen	37,482	Daniel P. McLoughlin	P-46,066
Edward R. Gates	31,616	Elizabeth R. Plumer	36,637	Ivan D. Zitkovsky	43,299	Robert H. Walat	P-46,324
Therese A. Hendricks	30,389	Timothy J. Oyer	36,628	Alan B. Sherr	42,147	Thomas G. Field	P-45,596
William R. McClellan	29,409	John N. Anastasi	37,765	Edward J. Russavage	43,069	Michael J. Pomianek	P-46,190
Ronald J. Krandsdorf	20,004	Helen C. Lockhart	39,248	John C. Gorecki	38,471	Theodore E. Galanthay	24,122
M. Lawrence Oliverio	30,915	James M. Hanifin, Jr.	37,929	William G. Gosz	27,787	Lisa K. Jorgenson	34,845
Jason M. Honeyman	31,624	Christopher S. Schultz	39,039	Neil P. Ferraro	39,188	Robert D. McCutcheon	38,717
James H. Morris	34,681					Jeff Moy	39,307

Adresser toute correspondance à:

Send correspondence to:
James H. Morris
Wolf, Greenfield & Sacks, P.C,
Federal Reserve Plaza
600 Atlantic Avenue, Boston, MA 02210-2211(USA)

Adresser tout appel téléphonique à: *(Nom et numéro de téléphone)*

Direct Telephone Calls to: (name and telephone number)
James H. Morris
(617) 720-3500

Nom complet de l'unique ou premier inventeur ISSON Olivier	Full name of sole or first inventor
Signature de l'inventeur Date 4 April 2000	Inventor's signature Date
Domicile 38700 LA TRONCHE, FRANCE	Residence
Nationalité French	Citizenship
Adresse Postale 24, Boulevard de la Chantourne	Post Office Address
Nom complet du second co-inventeur, le cas échéant NORDSTROM Tomas	Full name of second or joint inventor
Signature de l'inventeur Date 17 April 2000	Inventor's signature Date
Domicile 977 53 LULEA, SWEDEN	Residence
Nationalité Swedish	Citizenship
Adresse Postale Praktikantvägen 8	Post Office Address

(Fournir les mêmes renseignements et la signature de tout co-inventeur supplémentaire.)

(Supply similar information and signature for third and sub-sequent joint inventors.)